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NASA Procedural Requirements

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NPR 8715.6A
Effective Date: May 14, 2009
Expiration Date: May 14, 2014

Printable Format (PDF)

Request Notification of Change   (NASA Only)

Subject: NASA Procedural Requirements for Limiting Orbital Debris (w/ Change 1 - 5/14/09)

Responsible Office: Office of Safety and Mission Assurance

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Chapter 3. Program/Project Operations

3.1 Design

3.1.1 The NASA Program/Project Manager shall ensure that all NASA and NASA-funded or NASA-controlled spacecraft and launch vehicles are designed to be disposed of in accordance with the remainder of this chapter (Requirement 56843).

3.1.2 The NASA Program/Project Manager, with the NASA Center SMA organization, shall track and monitor the noncompliances (to this NPR and NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4) with the design and operations of the spacecraft and orbital launch vehicle stages beginning at PDR and shall have the tracking reviewed by the Center SMA organization prior to CDR and launch (Requirement 57313).

3.1.3 The NASA Program/Project Manager shall ensure that all spacecraft and launch vehicles placed in orbit about Earth or the Moon are designed to prevent/preclude, to the extent possible/feasible, a self-initiated unintentional on-orbit breakup from launch through reentry (Requirement 57314).

> *Note: See the U.S. Space Policy Section 11 (contained in paragraph P.1.1) for direction to NASA on limiting orbital debris NSS 1740.14, paragraph 4.4, or NASA-STD 8719.14, as applicable per paragraph P.2.4, for implementation of this requirement.*

3.2 Monitoring During Spaceflight

3.2.1 The NASA Program/Project Manager shall monitor their spacecraft and launch vehicle stages, to the extent possible/feasible, to detect intended or unintended operations that generate orbital debris around Earth, the Moon, or Mars, or at an Earth-Sun Lagrange point (Requirement 56848).

3.2.2 If the NASA Program/Project Manager has determined that a spacecraft in orbit around Earth or the Moon has (or may have) generated intended or unintended orbital debris which is outside of the ODAR or EOMP analyses, then the following offices shall be notified within 48 hours of identifying the release by the identifying party: MDAA, OSMA, and NASA ODPO and SOMD for debris generated in LEO (Requirement 56849).

3.2.3 The NASA Program/Project Manager shall ensure that all generated orbital debris in Earth orbit (planned and unplanned) is analyzed by the program/project to determine if within three months the orbital debris may either pose a risk to another spacecraft in a similar or crossing orbit or will return to Earth (Requirement 56850).

Note: The NASA ODPO will assist with this analysis when requested.

3.2.4 If analyses determines that orbital debris in orbit around the Earth or the Moon will pose a risk of occurrence greater than one in a thousand to another uninhabited spacecraft in a similar or crossing orbit for the three months after generation or decommissioning, then the MDAA shall notify the Chief/OSMA within 48 hours of completion of the analysis. Should the other spacecraft be inhabited (or inhabitable) and the risk of occurrence exceeds one in one million, then the MDAA shall notify the Chief/OSMA within 48 hours of completion of the analysis (Requirement 57316).

3.2.5 The NASA Program/Project Manager shall, for orbits about the Earth or the Moon, monitor spacecraft and launch vehicle stage items defined as critical in the ODAR or EOMP which may lead to a breakup or loss of control function or any items which may affect the planned maneuvers, passivation, or disposal at EOM (Requirement 56853).

3.2.6 For orbits about the Earth or the Moon, when an event is detected that may affect the generation of orbital debris or implementation of the EOMP, the NASA Program/Project Manager shall ensure that appropriate measures are taken to limit further generation of orbital debris that may preclude intended passivation and disposal of the spacecraft and launch vehicle stages (Requirement 56854).

3.2.7 The Program/Project Manager shall notify the Program's MDAA, who in turn, shall notify the Chief/OSMA and the NASA Chief Engineer, and SOMD (for missions that could pose a risk to humans in space) for events in LEO, within 96 hours of identifying the event when any of the following conditions occur (Requirement 56855):

a. The spacecraft no longer serves any useful function or purpose.

b. Redundancy or other key functionality is lost in the end-of-life disposal or deorbit system.

3.2.8 The Chief/OSMA and the NASA Chief Engineer shall be notified by the MDAA within one week when any of the following conditions occur (Requirement 56858):

a. The nominal propellant level required for controlled deorbit or disposal maneuvers is projected to occur in six months.

b. . Insufficient fuel remains onboard the spacecraft to perform all planned EOM maneuvers plus a 15 percent fuel margin.

3.2.9 The NASA Program/Project Manager shall provide copies of all actions per NPD 8010.3, Notification of Intent to Decommission or Terminate Operating Space Systems and Terminate Missions, to the OSMA with EOMP updates (Requirement 56861).

3.2.10 The NASA Program/Project Manager shall inform the Department of Defense's Space Surveillance Network prior to spacecraft and launch vehicle EOM maneuvers that result in a change of Earth orbit altitude of greater than 1 km (Requirement 56862).

3.3 EOM Actions

3.3.1 EOM Planning

3.3.1.1 The MDAA and the NASA Program/Project Manager shall periodically review and update the EOMP as a part of the Mission Directorate senior management review process (Requirement 56865).

3.3.1.2 All spacecraft planned for reentry into Earth's atmosphere or remaining in orbit about the Earth or the Moon shall be passivated at some point prior to abandonment of the spacecraft (Requirement 56866).

3.3.1.3 When significant capabilities affecting the spacecraft's planned ability to passivate, maneuver, or reenter at end-of-life change either through graceful degradation, malfunction, or via command, the EOMP shall be updated/annotated by the NASA Program/Project Manager (Requirement 56867).

3.3.1.4 EOM passivation includes all of the actions needed to prevent a breakup, either by explosion or disassembly from internally stored energy, of the spacecraft and launch vehicle from the point in time where EOM actions are begun and reentry of the spacecraft occurs.

3.3.1.5 The following systems shall be analyzed when passivation is required (Requirement 57317) (for further information on passivation, see NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4):

> Note: NASA-STD 8719.14 and NHBK 8719.14 provide assistance with developing methods of passivation that are consistent with preventing premature passivation errors or malfunctions.

a. Electrical Systems: Batteries and charging circuits.

b. Mechanical Pressure Systems: Propulsion, fluid loop, gas-pressurized batteries, and cryogenics.

c. Chemical Systems: Propulsion and solid motors.

d. Mechanical Systems: Rotating machinery and springs.

> Note: NASA-STD 8719.14 provides further details on methods of passivation on avoiding nonreversible passivation methods or unrecoverable passivation errors or malfunctions.

3.3.2 EOM Requirements for Spacecraft and Launch Vehicles Planned for Reentry Into Earth's Atmosphere or Remaining in Orbit About the Earth or the Moon

3.3.2.1 Maneuverable spacecraft that are terminating their operational phases at altitudes of less than 2000 km above the Earth shall be maneuvered to reduce their

orbital lifetime, commensurate with 25-year low-Earth orbit lifetime limitations, or relocated, when feasible, if analysis shows the probability of collision with large objects exceeds criteria for objects in these highly utilized orbit regions (Requirement 56876).

> *Note: Highly utilized orbits include those of the International Space Station and the NASA Earth Observing System. Note: This requirement is not intended to affect mission or spacecraft design/operations requirements established for portions of the mission that occur prior to EOM disposal.*

3.3.2.2 For controlled, commanded, or targeted reentries into Earth's atmosphere, the MDAA shall ensure that the OER notifies appropriate authorities for warnings to shipping lanes and airline routes in the area of the reentry a minimum of one week prior to reentry (Requirement 56879).

3.3.2.3 All spacecraft and launch vehicles shall be passivated as a part of EOM disposal/decommissioning to a level where the remaining internal stored energy is insufficient to cause breakup (Requirement 56880).

3.3.2.4 The Program/Project Manager shall include evaluation of the long-term perturbations on, and the future trajectories of, orbital spacecraft and launch vehicle stages in the EOMP (Requirement 56881).

3.3.2.5 The NASA Program/Project Manager shall ensure that all spacecraft and launch vehicles designed to be operated in GEO are designed to be able to maneuver at least 300 km above GEO altitude (closest approach to GEO greater than 300 km above GEO altitude) (Requirement 56882).

3.3.3 EOM Requirements While in Orbit About the Moon

3.3.3.1 The NASA Program/Project Manager shall not plan to leave objects in lunar orbit unless a documented need is stated in the ODAR (Requirement 56884).

> *Note: "Object" includes upper stage, spacecraft, free flyer, and debris.*

3.3.3.2 The NASA Program/Project Manager shall document the orbital parameters of all objects intended to be left in lunar orbit in the EOMP (Requirement 56885).

3.3.3.3 For disposal of spacecraft left in lunar orbit, the NASA Program/Project Manager shall document consideration of a change to the orbital parameters of the spacecraft such that it is not in an orbit where it may interfere with another active spacecraft and include this analysis in the EOMP (Requirement 56886).

3.3.3.4 The plan for disposal of a spacecraft on the lunar surface shall be concurred in by the Chief/OSMA (Requirement 56887).

> *Note: Concurrence may be noted using the EOMP.*

3.3.3.5 Reserved.

3.3.3.6 The Chief/OSMA, working with the MDAA or their designee, shall establish an advisory mechanism to assist in evaluating potential lunar crash sites for NASA spacecraft (Requirement 56889).

3.4 Conjunction Assessments during Mission Operations (for Earth-Orbiting Spacecraft)

3.4.1 The NASA Program/Project Manager shall have conjunction assessment analyses performed routinely for all maneuverable Earth-orbiting spacecraft with a perigee height of less than 2000 km in altitude or within 200 km of GEO (Requirement 56891).

3.4.2 Conjunction assessment analyses shall be performed using the USSTRATCOM high-accuracy catalog as a minimum (Requirement 56892).

3.4.3 The NASA Program/Project Manager shall have a collision risk assessment and risk mitigation process in place for all maneuverable Earth-orbiting spacecraft that are performing routine conjunction assessment analyses (Requirement 56893).

3.5 Special Requirements for Spacecraft Carrying Humans

3.5.1 The NASA Program/Project Manager shall have conjunction assessment analyses performed routinely for all maneuverable Earth-orbiting spacecraft with a mission orbit or temporary/transfer orbit perigee height of less than 2000 km in altitude or with orbits crossing within 200 km of GEO (Requirement 56895).

3.5.2 The Program/Project Manager shall notify the Chief/OSMA 48 hours in advance of a planned jettison of an object(s) (Requirement 56896).

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